

NEW TECHNOLOGIES ARE ADDRESSING DIESEL PARTICULATE EMISSIONS UNDERGROUND

JANUARY 2019

In Australian coal mines, diesel vehicles are the primary means of transporting workers and materials underground. However, diesel particulate matter (DPM) from vehicle exhaust is a potential health hazard, particularly given the confined conditions underground. To address this issue, disposable filter systems are installed on diesel vehicles. While these filters are efficient at removing DPM, they represent a significant operating cost (up to \$164 million annually in New South Wales coal mines).

In addition, as mines become deeper, it takes longer for workers and materials to reach their destination underground using existing transport methods. This situation has the potential to impact on productivity.

A multi-faceted research approach was needed to:

- address the limitations of existing DPM filter technology
- investigate alternative energy sources for underground vehicles and machinery; and
- provide rapid transport of workers underground.

Industry target

- Reduce health and safety risks from diesel particulate emissions by mitigating or removing DPM
- Reduce operational costs of controlling the emission of diesel particulates
- Reduce waste (disposable filters)
- Rapid transport of workers and materials underground.

ACARP industry investment

- \$2.7 million across 5 projects

Research results

Wall-flow Diesel Particulate Filters (DPF) system

- A wall-flow DPF is an exhaust filter system that traps diesel particulate emissions using the porous structure of the ceramic substrate of the filter element. Once trapped, the particulate components are oxidised through regular cycling of elevated temperature and/or catalytic reactions.
- The proof-of-concept system has demonstrated a reduction in DPM emissions and its robustness proven on a load-haul-dump machine
- An 80% reduction in operating costs over a three-year period is forecast, since the wall-flow DPF is not disposable, but self-regenerating filter
- System has potential as an OEM or retrofitted solution
- The system has a tamper-proof design which mitigates the risk of operating unfiltered diesel equipment in poorly ventilated areas
- The researcher is addressing issues to meet regulatory requirements in current extension projects.

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Lithium battery

- A design has been developed for an energy dense, heavy duty battery based on a lithium chemistry to meet the standards of certification required for operation in underground coal mine atmospheres
- The primary purpose for developing the battery is to power electric transport vehicles and underground machinery i.e. replace diesel powered vehicles
- The design has been verified against International Electrotechnical Commission standards
- The project is ready to progress to next phase which includes the battery builds, researcher trials and formal testing and certification by the testing authority. After achieving the required level of certification, the battery is planned to be integrated into a personnel transporter as a proof of concept
- Battery modules with the same capacity and similar features are being integrated into hard-rock electric vehicles and will undergo mine site trials in 2019.

Underground compressed air vehicle

This project aims to:

- Develop a prototype transport vehicle that runs on compressed air
- Test the practical application of compressed air engines as a replacement for existing diesel-powered transport vehicles
- Establish the range of one tank of compressed air by testing in actual mining conditions
- Eliminate diesel particulates in the underground environment
- Develop a vehicle that can be driven in an atmosphere that doesn't support combustion (emergency escape capabilities)
- Potentially reduce capital and operating costs because flameproof equipment is not needed for compressed air vehicles.

Return on investment

- Protect underground workers from DPM emissions
- Significant reduction in operating costs to control DPM emissions
- Lithium batteries offer a viable alternative energy source to diesel
- Electric vehicles reduce noise, heat, maintenance and have no emissions
- Potential to eliminate diesel particulate emissions underground
- Compressed air vehicles represent a low risk in hazardous zones
- Rapid transport of workers underground
- Machine flexibility to drive anywhere without the use of cabling.

Importance of ACARP

- Provides researchers with a 'whole of industry' perspective that helps to facilitate practical project outcomes
- Provides a forum for researchers, industry representatives and regulators to provide input into solutions to industry challenges
- Has the ability to fund a range of projects from retrofit options that can be implemented in the short term, to blue sky concepts. This approach ensures a pipeline of ongoing research to address known industry challenges
- Provides a mechanism through which issues that concern the industry can be addressed.